A NEW ALDEHYDE SYNTHESIS

Sir:

We have found that the Wittig olefin synthesis[1] can be extended to the synthesis of certain aldehydes by way of their enol ethers:

$$(C_6H_5)_3P + ClCH_2OCH_3 \longrightarrow \underset{I}{[(C_6H_5)_3PCH_2OCH_3]^+Cl^-}$$

$$I \xrightarrow{C_6H_5Li} \underset{II}{(C_6H_5)_3P{=}CHOCH_3}$$

$$-\overset{|}{\underset{|}{C}}{=}O \xrightarrow{II} -\overset{|}{\underset{|}{C}}{=}CHOCH_3 \xrightarrow{H_3O^\oplus} -\overset{|}{\underset{|}{C}}HCHO$$

Triphenyl-(methoxymethyl)-phosphonium chloride (I) (m.p. 191–193°; Calcd for $C_{20}H_{20}ClOP$: Cl, 10.34. Found: Cl, 10.24) from triphenylphosphine and chloromethyl methyl ether, was finely powdered, suspended in anhydrous ether, and stirred under a nitrogen atmosphere while one equivalent of ethereal phenyl lithium was gradually added. The resulting deep red solution, presumably containing methoxymethylenetriphenylphosphorane (II) in two-fold excess, reacted with 5α,22β,25D-spirostan-3-one[2] (tigogenone), yielding 85% of 3-methoxymethylene-5α,22β,25D-spirostane (III) (m.p. 178–181°, $[\alpha]^{23}D$ −65.8°, $\bar{\nu}_{max.}$ 1683 cm.$^{-1}$. Calcd. for $C_{29}H_{46}O_3$: C, 78.68; H, 10.47. Found: C, 78.90; H, 10.37). Brief treatment of this enol ether with diethyl ether, previously saturated with 72% perchloric acid, resulted in nearly quantitative hydrolysis to 5α,22β,25D-spirostane-3-carboxaldehyde (IV), as a mixture of epimers (m.p. 160–170°, $[\alpha]^{23}D$ −57.4°, $\bar{\nu}_{max.}$ 2693, 1731 cm.$^{-1}$. Calcd. for $C_{28}H_{44}O_3$: C, 78.45; H, 10.34. Found: C, 78.59; H, 10.45).

This reaction sequence, when applied to the synthesis of the expected aldehydes from cyclohexanone and from acetophenone using a 100% excess of the reagent (II), resulted in incomplete reaction and lower over-all yields. Thus, from cyclohexanone, was obtained cyclohexanecarboxaldehyde 2,4-dinitrophenylhydrazone (40%), m.p. 172–173° alone or admixed with an authentic sample.[3] Acetophenone was converted in similar over-all yield to hydratropaldehyde semicarbazone, m.p. 150–151° (lit.,[4] 153–154°), which was further identified by direct conversion to the 2,4-dinitrophenylhydrazone, m.p. 134–135° (lit.,[4] 135°).

The above synthetic method for the transformation $-\overset{|}{\underset{|}{C}}{=}O \rightarrow -\overset{|}{\underset{|}{C}}HCHO$ promises to offer certain advantages over the established glycidic ester sequence[5]: (1) milder reaction conditions; (2) avoidance of certain side reactions[6]; (3) possible utility of the enol ether intermediate as a "protected" aldehyde group or (4) as a starting substance for alternative transformations.

(1) For leading references, see G. Wittig, *Angew. Chemie*, **68**, 505 (1956).

(2) R. W. Marker, T. Tsukamoto and D. L. Turner, THIS JOURNAL, **62**, 2525 (1940).

(3) Kindly furnished by Prof. W. S. Johnson.

(4) C. F. H. Allen and J. van Allan, *Organic Syntheses*, **24**, 87 (1944).

(5) Houben-Weil, "Methoden der Organischen Chemie," Vol. VII, part 1, Georg Thieme Verlag, Stuttgart, 1954, p. 326.

(6) W. S. Johnson, J. S. Belew, L. J. Chinn and R. H. Hunt, THIS JOURNAL, **75**, 4995 (1953).

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
EASTERN UTILIZATION RESEARCH AND DEVELOPMENT DIVISION
PHILADELPHIA 18, PENNSYLVANIA
SAMUEL G. LEVINE

RECEIVED OCTOBER 22, 1958